Monitoring Network Design, Implementation & Data Management

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USGS Center for Integrated Data Analytics

Our Mission:

The USGS Center for Integrated Data Analytics is committed to advancing USGS science and a broader understanding of our changing world by integrating disparate data across scales and domains, improving access to data and scientific findings, and developing solutions for analysis and visualization in collaboration with domestic and global partners in order to enable a new era of scientific investigation.

Agile Project Management

Value is achieved faster due to frequent software releases.

Plan

Design

Build

Test

Release
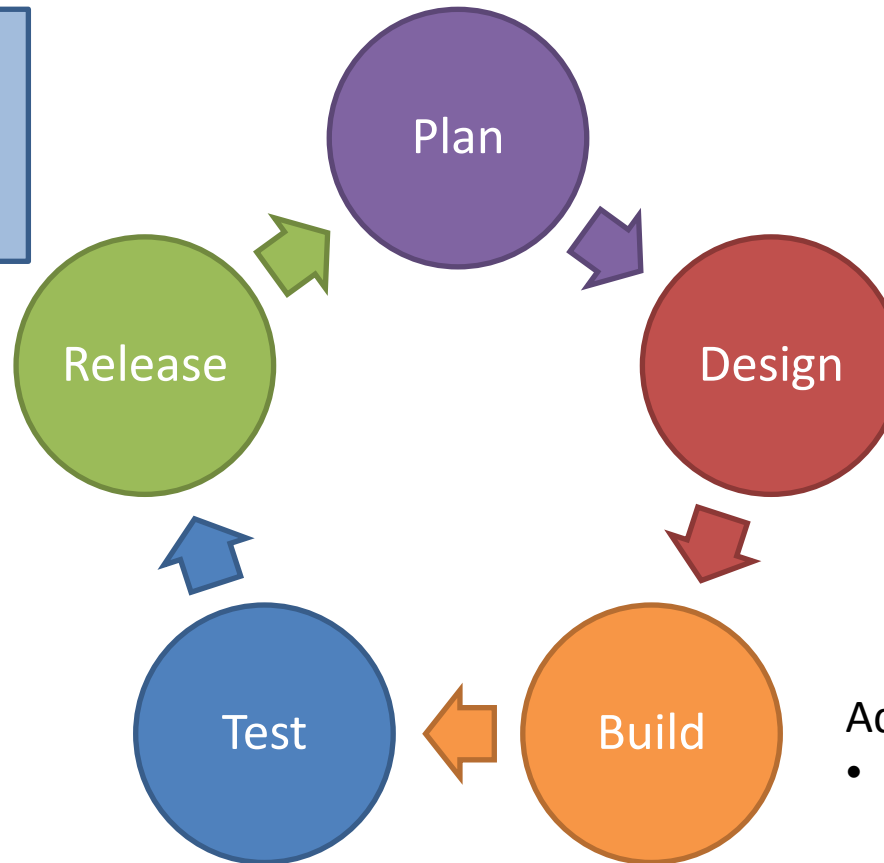
Advantages:
- Continuous product improvement
- Short feedback cycles

Best Practices

Use Open Standards

Consider Your Users

Agree on Requirements & Adjust as You Go
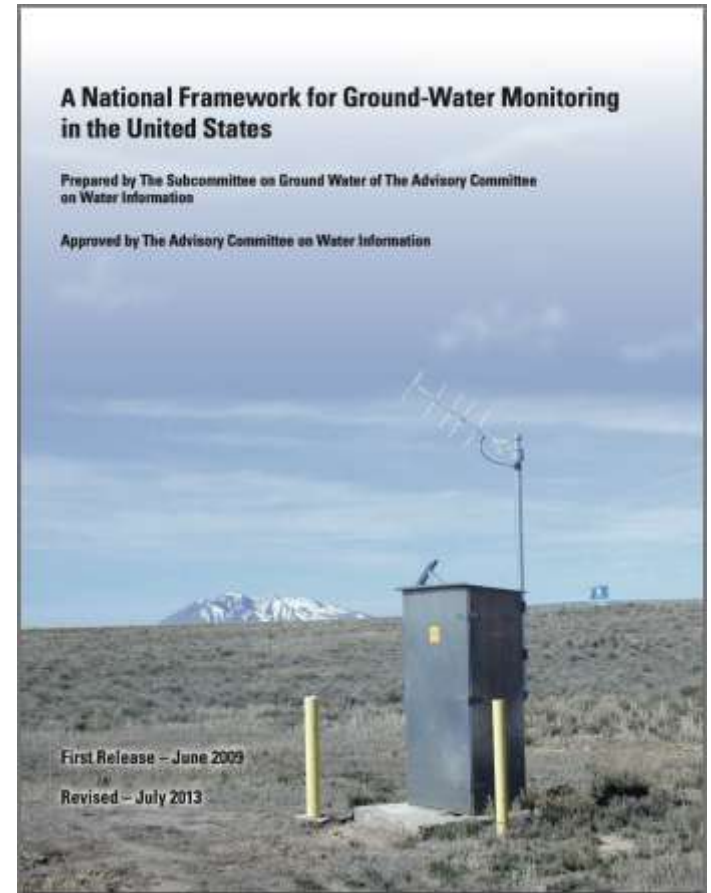
Walk before you run!

Design, Architecture & Lessons Learned

NGWMN DATA PORTAL

National Ground-Water Monitoring Network

- Collaboration-Driven

- Feasible Design

- Framework Document

- Inventory of Programs

- Guidance for Field Methods

- Guidance for Data Mgmt

- Data Elements

- Pilot Implementation

A National Framework for Ground-Water Monitoring in the United States

Prepared by The Subcommittee on Ground Water of The Advisory Committee on Water Information

Approved by The Advisory Committee on Water Information

First Release – June 2009

Revised – July 2013

National Ground-Water Monitoring Network

Objectives:

To create a single publicly accessible, automated data portal to relay groundwater levels, groundwater quality data and associated lithology and well construction information from distributed databases through a national map interface in real-time.

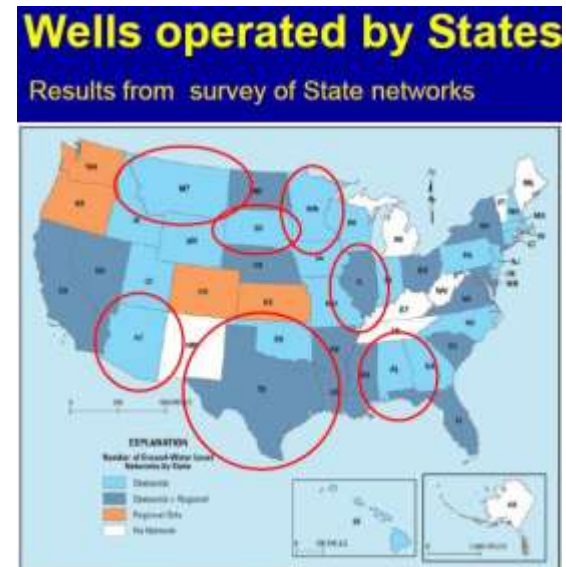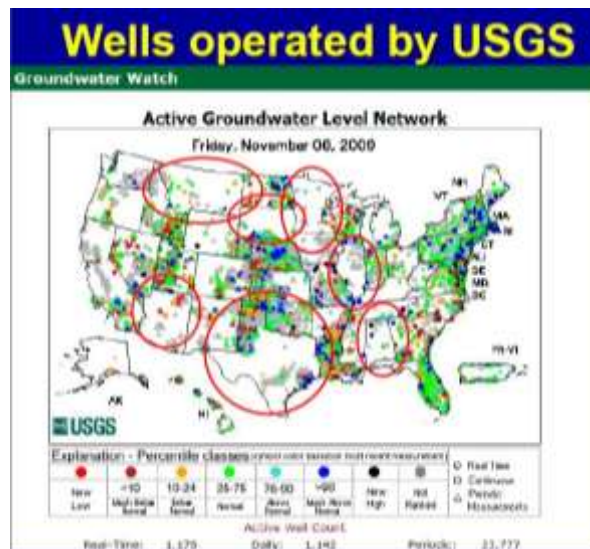## Principals:

Distributed → Data stays with owner

Seamless → Acts as one virtual database

Multi-access → Multiple portals, tools

Standards Based → OGC's WFS & SOS, EPA's WQX, WaterML, GWML, GeoSciML

Wells operated by USGS — Groundwater Watch — Active Groundwater Level Network — Friday, November 06, 2009

Wells operated by States — Results from survey of State networks

National Groundwater Monitoring Network

ACWI — Advisory Committee on Water Information

NGWMN NETWORKS

NGWMN NETWORKS

Water level: ☑

Subnetwork:
- All
- Background
- Suspected Changes
- Known Changes

Monitoring Category:
- All
- Surveillance
- Trend
- Special

Water quality: ☑

Subnetwork:
- All
- Background
- Suspected Changes
- Known Changes

Monitoring Category:
- All
- Surveillance
- Trend
- Special

FILTER MAP DATA

Principal Aquifer

Available Data

Water Level | Water Quality | Well Log

Contributing Agency

CURRENT VIEW

2559 Sites Mapped
2343 water-level network wells
545 water-quality network wells

TIPPECANOE 17 (TC 17)

SUMMARY | WELL LOG | WATER LEVELS | WATER QUALITY

Agency	U.S. Geological Survey (National Water Information System)
Site Name	TIPPECANOE 17 (TC 17)
Site #	402734087022401
Lat/Long(WGS84)	40.4606, -87.0606
Well Depth	212.54 ft
Local Aquifer Name	Outwash
National Aquifer Name	Sand and gravel aquifers (glaciated regions)
Water Level Network	Surveillance - Background
Water Quality Network	Unknown - Unknown

SELECT FOR DOWNLOAD

INDIANA DEPARTMENT OF NATURAL RESOURCES

BIG SPRING FISH HATCHERY WELL PWFL #4

SUMMARY | WELL LOG | WATER LEVELS

Month/Year

SELECT FOR DOWNLOAD

SMITH AL

SUMMARY | WELL LOG | WATER LEVELS

Longitude: 47.2237
Latitude: -106.9189
Elevation: 2626.00 ft
Well Depth: 145.00 ft

Depth From (ft)	Depth To (ft)	Lithology	Description
140.00	145.00	CLAY	CLAY
110.00	140.00	SAND	SAND
20.00	110.00	SHALE	SHALE
15.00	20.00	COAL	COAL
12.00	15.00	ROCK	ROCK
0.00	12.00	SAND	SAND

SELECT FOR DOWNLOAD

Site Selection

Site Name	Agency	WL	WQ	Log
GREAT NORTHERN RAILWAY COMPA...	MBMG	●		●
PIA-2000A Cisco	ISWS	●		●
TWDB-7764401	TWDB	●		●
250790-- Imlaystown MW1	USGS		●	●
GRANT 10 (GT 10)	USGS	●	●	●
66018	MN DNR	●		●
MPCA Ambient Network Site 1152	MPCA		●	

7 sites selected.

REMOVE SELECTED | DOWNLOAD

CANADA

Great Lakes

UNITED STATES

ROCKY MOUNTAINS

Pacific Ocean

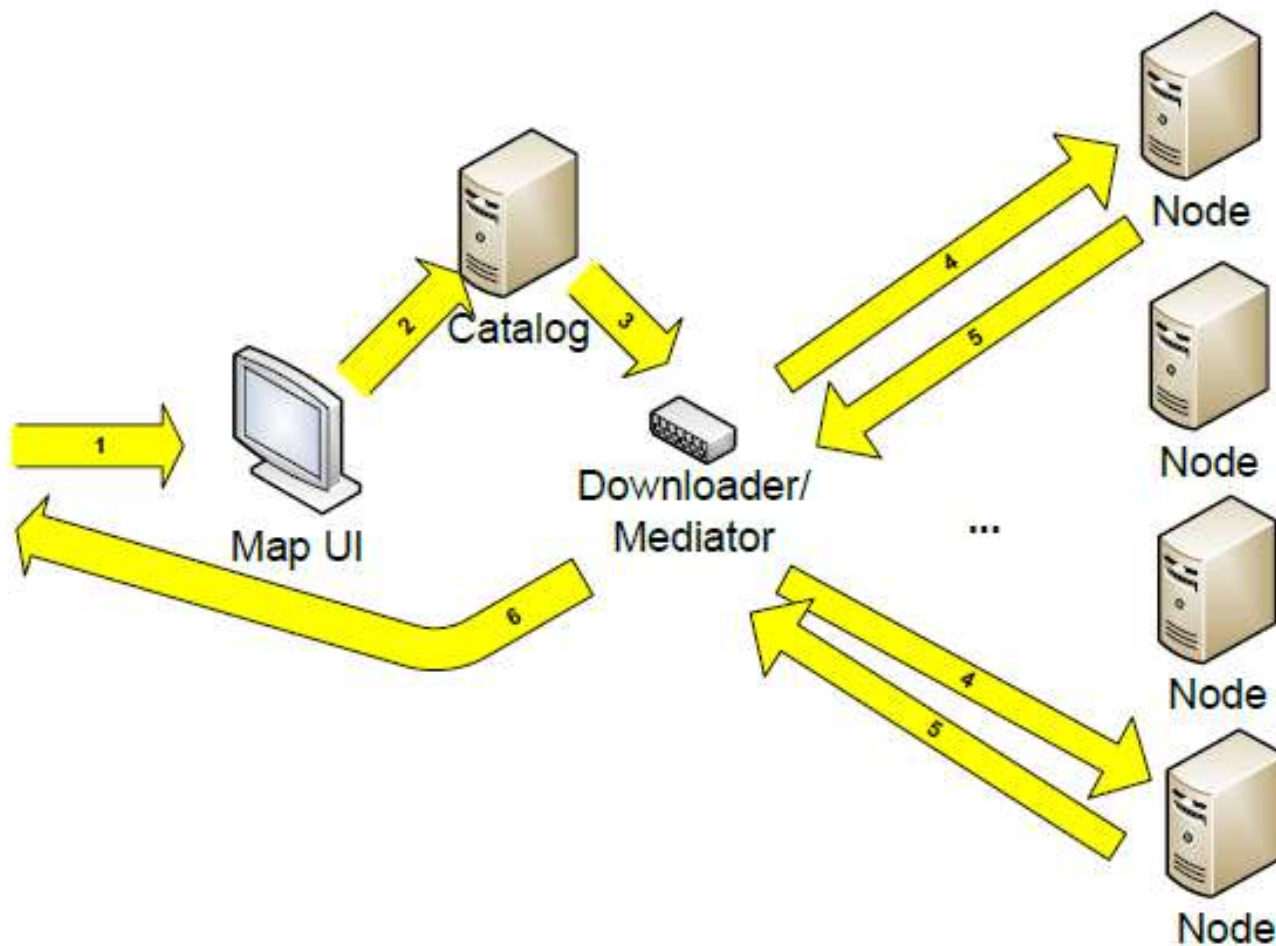Atlantic Ocean

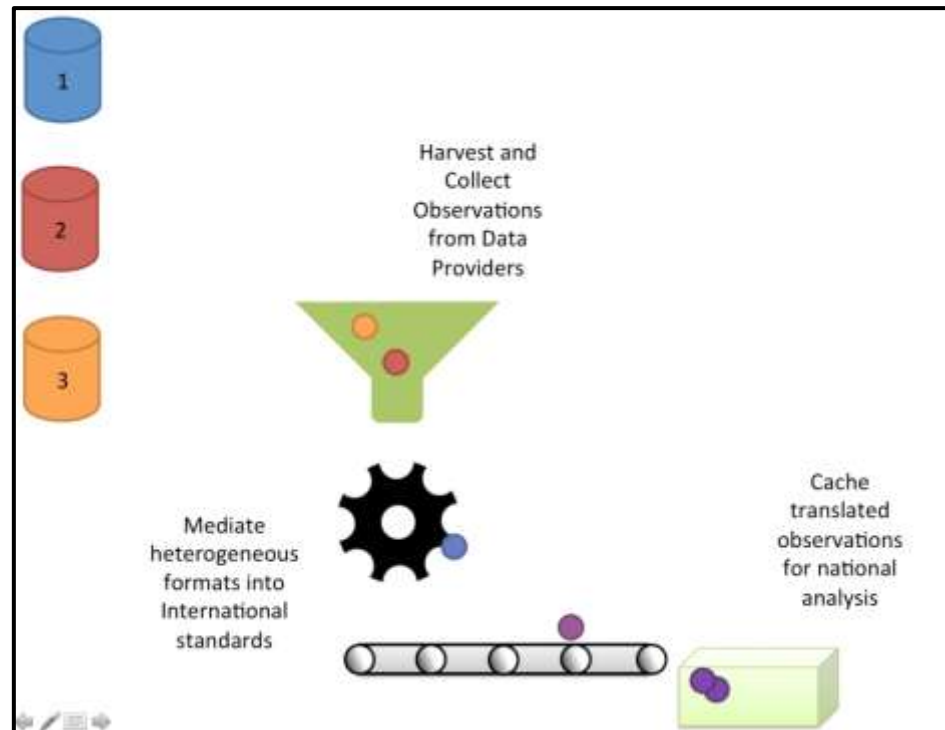Gulf of Mexico

MEXICO

Caribbean Sea

1000 km
1000 mi

-54.664802, 67.006133

NGWMN Architecture

NGWMN Cache

- Improved: Performance, Reliability, Stability
- Enables advanced querying
- Data availability filtering
- Cache runs daily

National Ground-Water Monitoring Network

Design Specification

- 10's – 100's k Sites
- Distributed data sources
- 100's Data Providers

- Hand-picked sites
- Continuous & discrete data
- Single end-point data access

{+} Advantages

- Data providers maintain ownership
- Stable & Reliable data
- Advanced querying capabilities
- Re-usable back end web services
- On-the-fly transformation

{-} Disadvantages

- Network intensive
- Processing intensive
- Potentially stale data (< 1day)
- Initial set-up for each provider

USGS
science for a changing world

CIDA
Center for Integrated Data Analytics

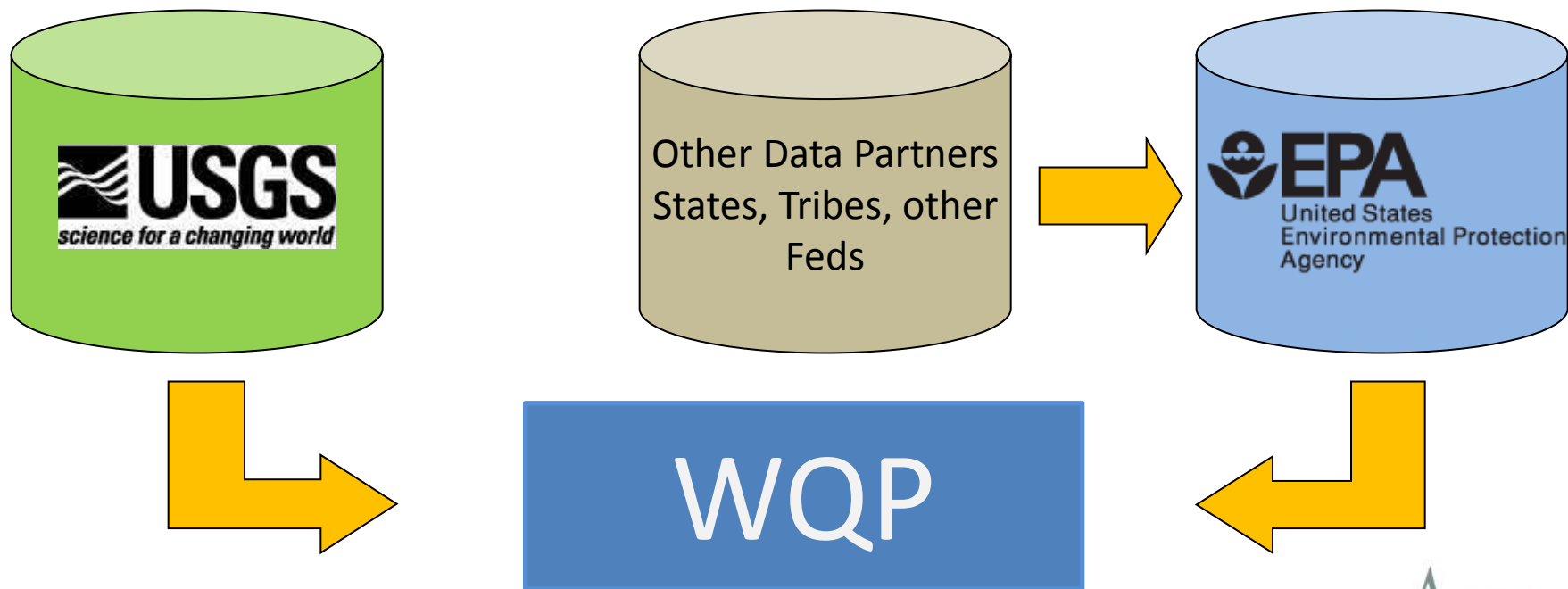Design, Architecture & Lessons Learned

WATER QUALITY PORTAL

Search over 150 million water-quality data records from States, Tribal Partners, USEPA, and USGS

Water Quality Portal

The WQP integrates publicly available water-quality data from the USGS **NWIS** and the EPA **STORET** Data Warehouses.

Other Data Partners States, Tribes, other Feds

WQP

Water Quality Portal

LOCATION

Country: US   select

State: US:41   select

County: US:41:005;US:41:007; select

Point location: ?

Within: [ ] miles from:

Lat: [ ]   Long: [ ]

my location

Bounding box: ?

North: [ ]

West: [ ]   East: [ ]

South: [ ]

SITE PARAMETERS

Site Type: Stream   select

Organization ID: [ ]   select

Site ID: [ ]   ?

HUC: [ ]   ?

SAMPLING PARAMETERS

Sample Media: Water   select

Characteristic Group: Nutrient   select

Characteristics: [ ]   select

Date range: from 01-2005 to [ ]   (mm-dd-yyyy)

DOWNLOAD

Select database: ⦿All databases ○USGS NWIS only ○EPA STORET only

Select data: ⦿Sites only ○Sample results only

Download tabular data:
File format:
⦿Comma-separated
○Tab-separated
○MS Excel (Excel 2003 and earlier versions have a limit of 65,536 rows. If your download exceeds this limit, only the first 65,536 rows will open.)
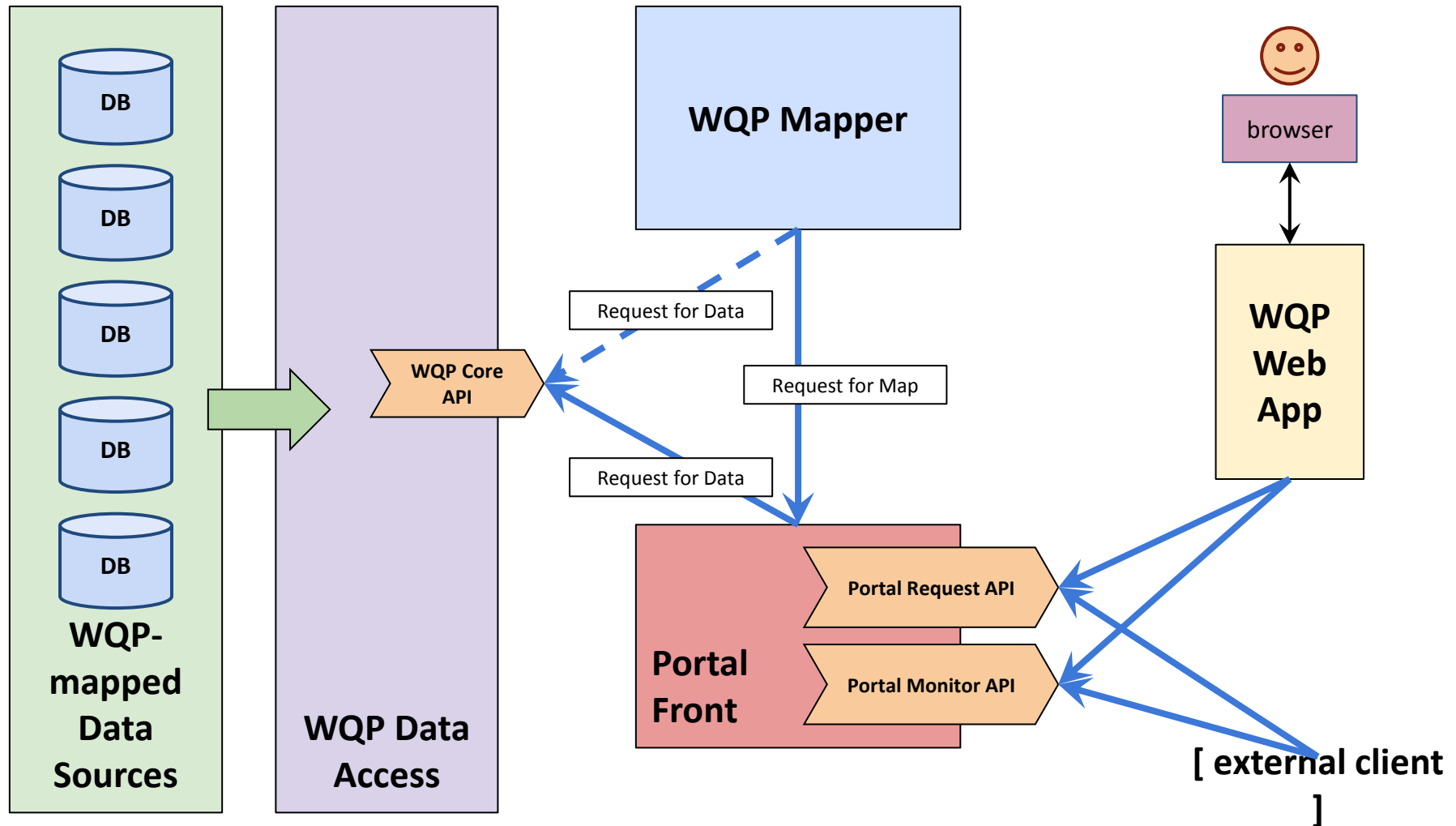
Download map data:
File format:
○KML (Keyhole Markup Language - this is available for Sites only)

Show data on Google Maps *Google Maps limits the number of sites shown to a maximum of 1000. It will also time out if the query is slow.*

DOWNLOAD

Show RESTlike queries ?

WQP Architecture

WQP Mapper

WQP-mapped Data Sources

DB
DB
DB
DB
DB

WQP Data Access

WQP Core API

Request for Data

Request for Map

Request for Data

Portal Front

Portal Request API

Portal Monitor API

browser

WQP Web App

[external client]

Water Quality Portal

Design Specification

- Millions of Sites
- Distributed data sources
- < 5 Data Providers

- Only discrete data
- Automatic addition of sites
- Single end-point data access

{+} Advantages

- Data providers maintain ownership
- Stable & Reliable data(?)
- Advanced querying capabilities
- Full service API

{-} Disadvantages

- Network intensive
- Data must be provided in standard format
- QA/QC is difficult

Lessons Learned

- Data Quality can be an issue

- Network intensive

- Processing intensive

- Dependence on data provider infrastructure

- Potential lag time

Design Considerations

- Grass-roots or top down approach?
- # Data Providers
- # Sites (or entities monitored)
- Who is responsible for QA/QC?
- How will metadata be managed?
- What type of data and data format(s)?
- Real-time or is a delay ok?
- How will the data be queried?

Thank You!

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Photo Credit: Jesse Juchtzer